15 Roundabouts

Slides — **15A. Roundabouts and Access Management**

Bruce Robinson, Kittelson & Associates, Inc.

Joe Bared, FHWA

Paper

Slides — **15B. Modern Roundabouts as an Access Management Tool**

Richard Perez, City of Federal Way, Washington

Roundabouts and Access Management

Bruce W. Robinson
Principal Investigator
Roundabouts: An Informational Guide
http://www.tfhrc.gov/safety/00068.htm

Kittelson & Associates, Inc.
Portland, Oregon USA

Agenda

- Introduction
  - FHWA Project Overview
  - Roundabout Categories
- Performance
  - Operations
  - Safety
- Design Principles
- Access Management Issues and Applications

Project Overview

- Project began October 1997
- Variety of sources
  - Best practices internationally
  - Current research in U.S.
  - Adaptation to U.S. standard practice
  - Judgment of authors and reviewers

Project Team

- Prime: Kittelson & Associates, Inc.
- Researchers
  - University of Florida
  - University of Idaho
  - Penn State University
  - Queensland Univ. of Technology (Australia)
  - Ruhr-University Bochum (Germany)
- Practitioners
  - Hurst-Rosche Engineers, Inc. (MD/PA)
  - Buckhurst Fish & Jacquemart, Inc. (NY)
  - Eppell Olsen & Partners (Australia)

Publishing schedule

- Electronic version
  - Available on Internet at the Turner Fairbank Highway Research Center website
  - http://www.tfhrc.gov/safety/00068.htm
- Paper version
  - Expected September
  - Fax order requests: (301) 577-1421

Organization of the Guide

- Chapter 1: Introduction
- Chapter 2: Policy Considerations
- Chapter 3: Planning
- Chapter 4: Operational Analysis
- Chapter 5: Safety
- Chapter 6: Geometric Design
- Chapter 7: Traffic Design and Landscaping
- Chapter 8: System Considerations

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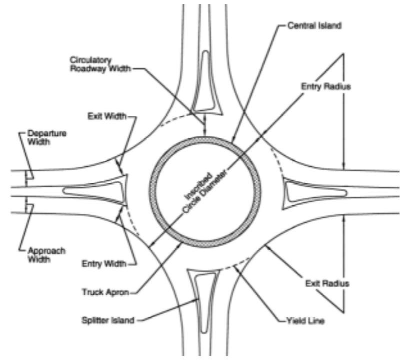
- **Design Principles**
- **Access Management Issues and Applications**

Key Dimensions



Roundabout Categories

Minimum Sizes Determined by Design Vehicle – but automobile speed (safety) tradeoff, therefore keep "tight"

Site Category	Typical Design Vehicle	Inscribed Circle Diameter Range*	
Mini-Roundabout	Single-Unit Truck	13 – 25 m	(45 – 80 ft)
Urban Compact	Single-Unit Truck/Bus	25 – 30 m	(80 – 100 ft)
Urban Single Lane	WB-15 (WB-50)	30 – 40 m	(100 – 130 ft)
Urban Double Lane	WB-15 (WB-50)	45 – 55 m	(150 – 180 ft)
Rural Single Lane	WB-20 (WB-67)	35 – 40 m	(115 – 130 ft)
Rural Double Lane	WB-20 (WB-67)	55 – 60 m	(180 – 200 ft)

* Assumes 90-degree angles between entries and no more than four legs.

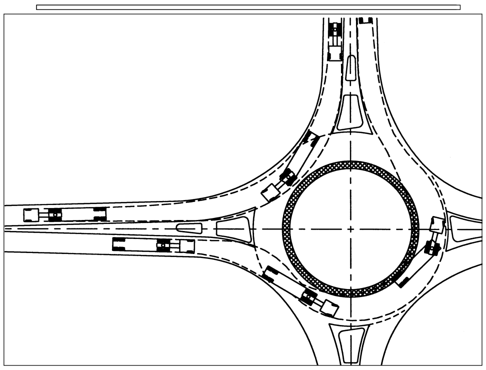
Design Vehicle

Good design

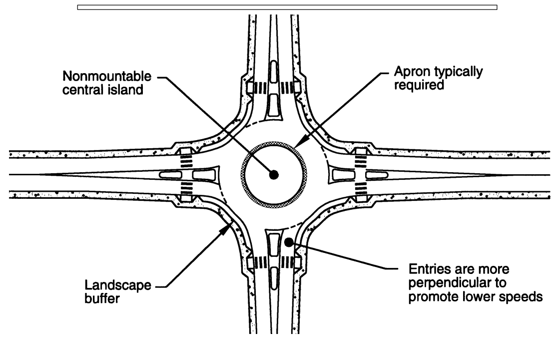
- **May require use of truck apron**
- **Minimizes damage to curbs, signs, landscaping**

Poor design

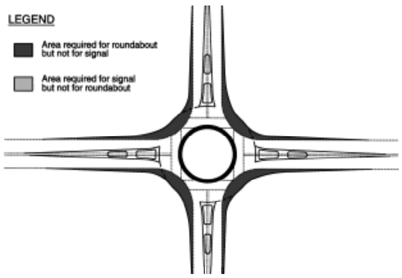
Design Vehicle



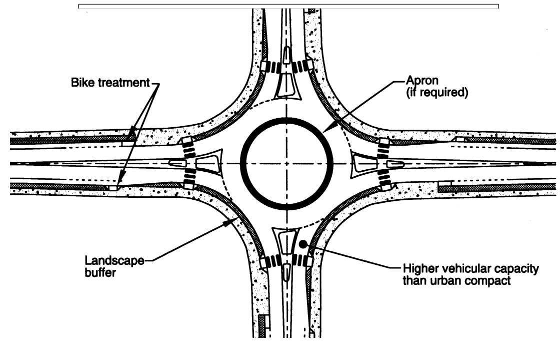
Urban Compact Roundabouts



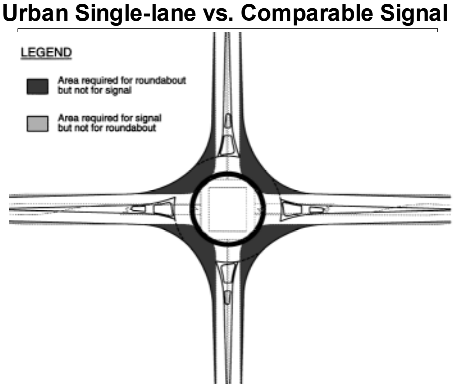
Space Requirements
Urban Compact vs. Comparable Signal



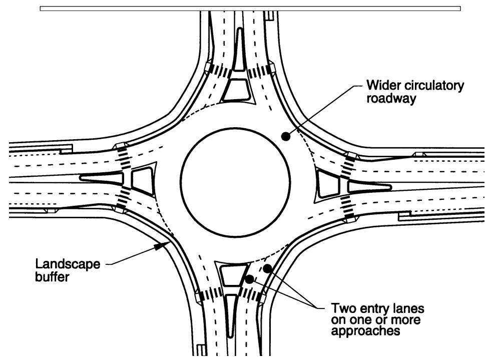
Urban Single-Lane Roundabouts



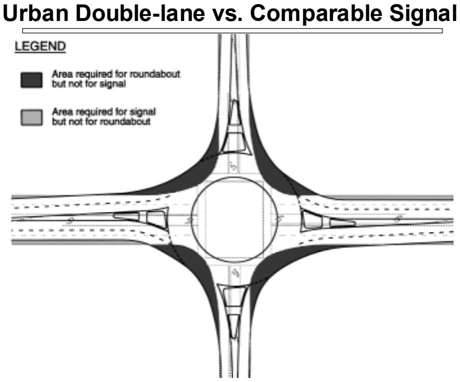
Space Requirements
Urban Single-lane vs. Comparable Signal



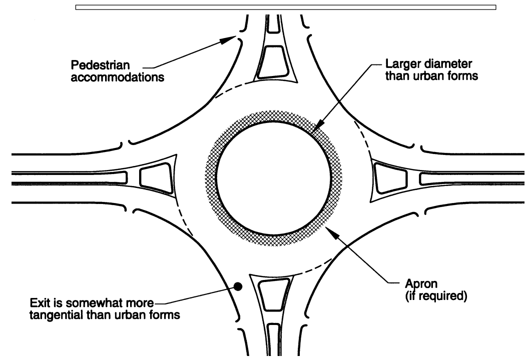
Urban Double-Lane Roundabouts



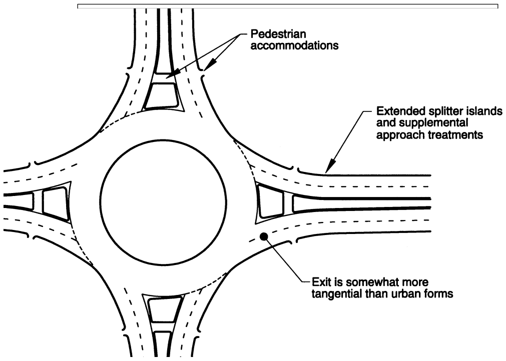
Space Requirements
Urban Double-lane vs. Comparable Signal



Rural Single-Lane Roundabouts



Rural Double-Lane Roundabouts



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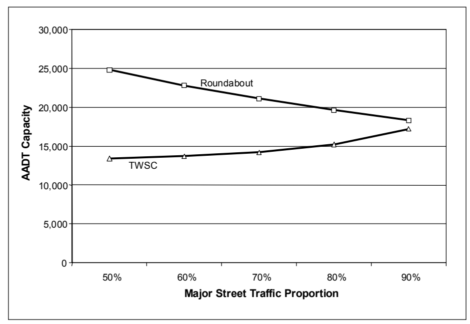
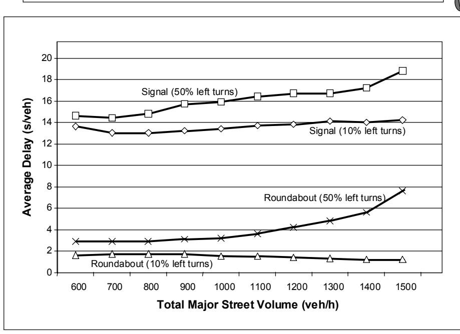
Comparisons with Other Control

- Higher capacity & lower delay than AWSC
- No improvement on TWSC if minor movements have no operational problems
- Single-lane roundabout is within capacity when peak hour volume warrants for signals are not met
- If Rbt .within Capacity - generally lower delays and queues than Signals

Roundabouts versus TWSC



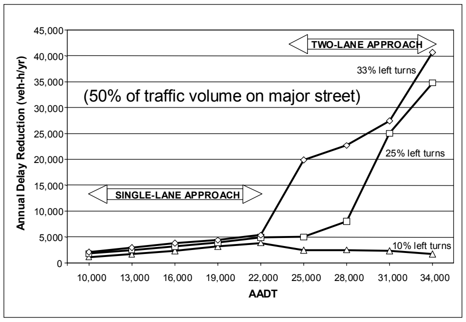
Roundabouts at MUTCD Peak Hour Signal Warrant Volumes



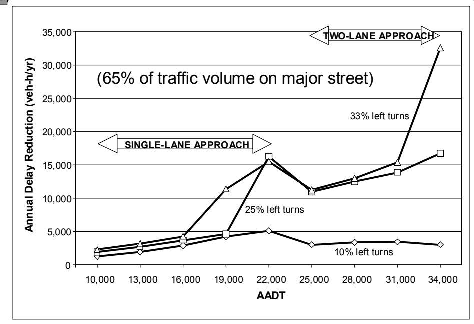
Roundabouts versus Signals

- Roundabouts produce less delay than comparable signals if operating within their capacity
- Heavy left turn - good candidates
- Off-peak periods are important in comparing annual delay savings

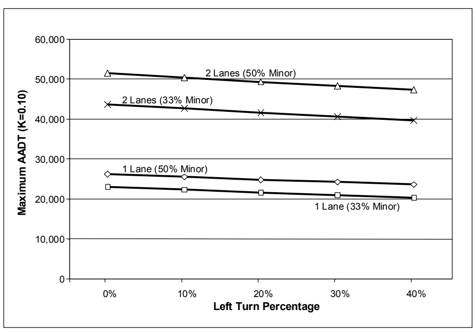
Roundabouts versus Signals 50/50



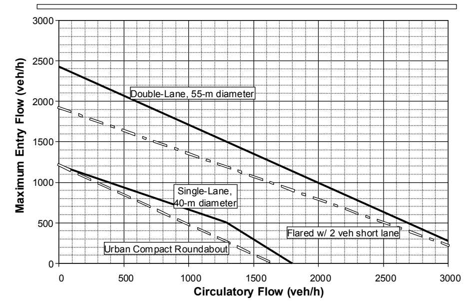
Roundabout versus Signals 65/35



Maximum ADT (4-legged intersection)

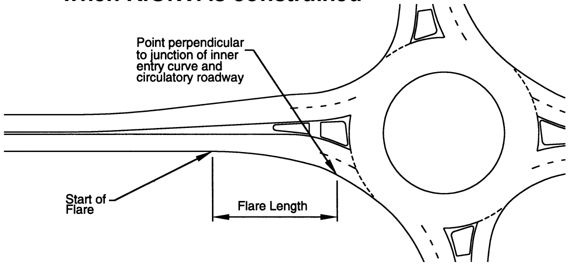


Capacity Comparison



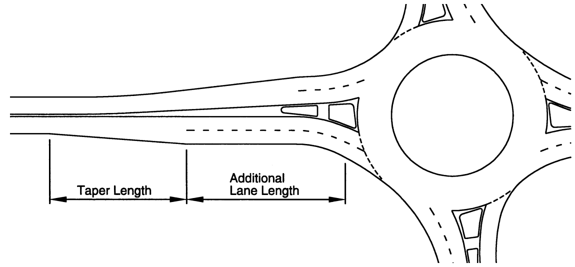
Flared Entry

- **Entry flaring is a tool to increase capacity when R.O.W. is constrained**



Flare: Alternative Short Lane Design

- **Widening by adding a full lane**

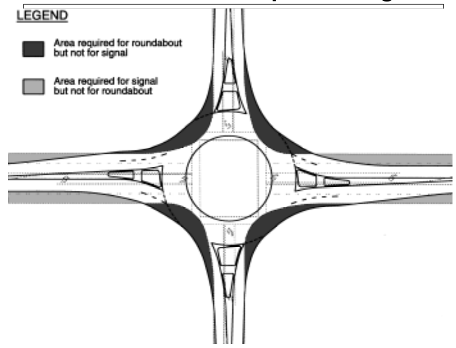


Capacity adjustments: Short lanes

- Short lanes are the additional partial lanes added when flaring a roundabout from one to two lanes

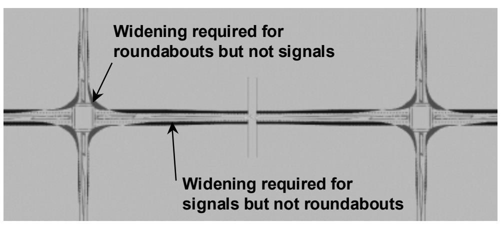
No. of vehicle spaces in short lane	Capacity factor (applied to double-lane approach capacity)
0 (single-lane approach)	0.500
1	0.707
2	0.794
4	0.871
6	0.906
8	0.926
10	0.939

Space Requirements
Urban Flared vs. Comparable Signal



Wide Nodes and Narrow Roads

- Roundabouts provide opportunity to minimize widening between intersections



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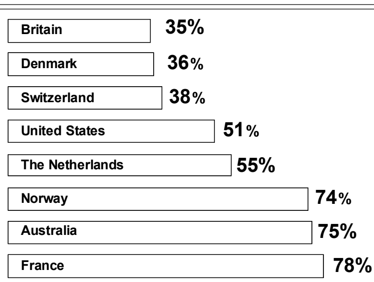
Injury Crash Reductions



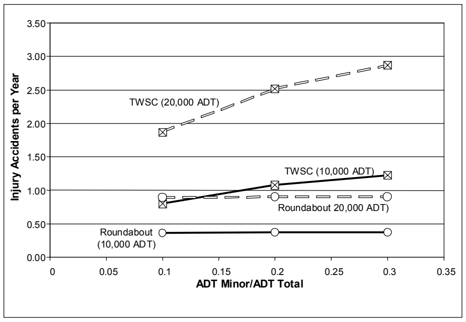
Source: Maryland Department of Transportation; NCHRP Synthesis 279

U.S. Before-After Experience
Insurance Institute for Highway Safety

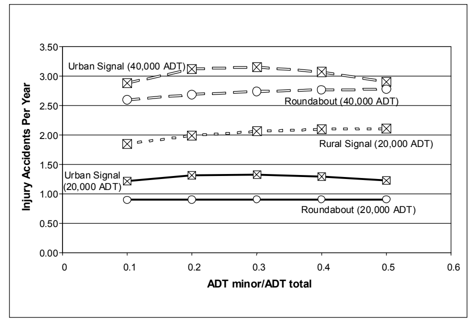
- March 2000 study (Persaud, et al.)

Group characteristic before conversion (sample size)	% reduction in all crashes	% reduction in injury crashes
Single-lane, urban, stop-controlled (9)	61	77
Single-lane, rural, stop-controlled (5)	58	82
Multilane, urban, stop-controlled (7)	15	N/A
Urban, signalized (3)	32	68

Predicted Injury Crashes Rural Roundabouts versus TWSC



Predicted Injury Crashes Urban Roundabouts versus Signals



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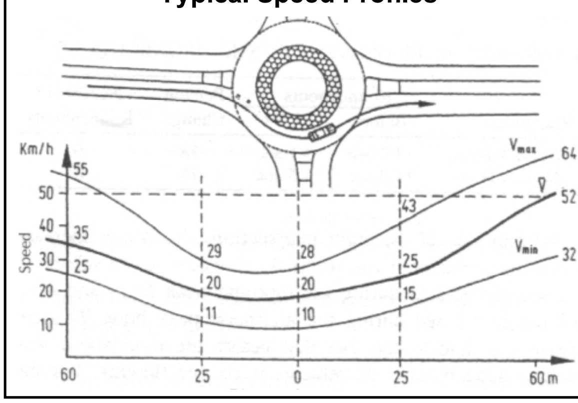
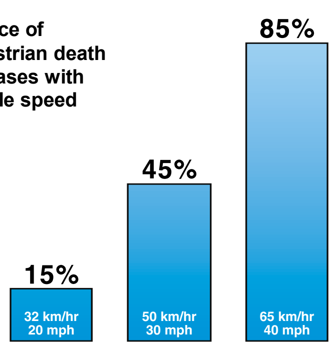
Typical Speed Profiles



Speed and Pedestrians

Chance of pedestrian death increases with vehicle speed



Vehicle Path Radii

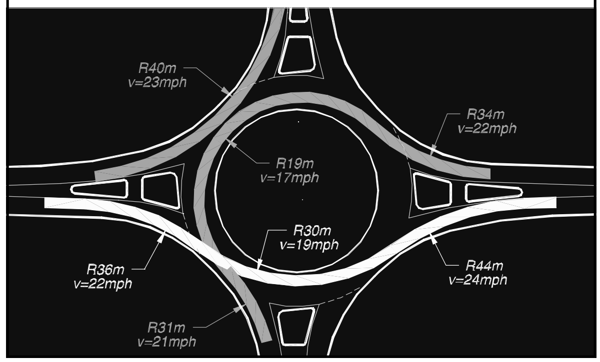
Site Category	Recommended Maximum Entry Design Speed
Mini-Roundabout	25 km/h (15 mph)
Urban Compact	25 km/h (15 mph)
Urban Single Lane	35 km/h (20 mph)
Urban Double Lane	40 km/h (25 mph)
Rural Single Lane	40 km/h (25 mph)
Rural Double Lane	50 km/h (30 mph)

Vehicle Path Radii

- Speed – curve relationship
- Based on AASHTO Green Book
- Metric: $V = \sqrt{127R(e+f)}$
- U.S. Customary: $V = \sqrt{15R(e+f)}$

where:
V = Design speed, km/h (mph)
R = Radius, m (ft)
e = superelevation, m/m (ft/ft)
f = side friction factor

Speed Consistency



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Access Management

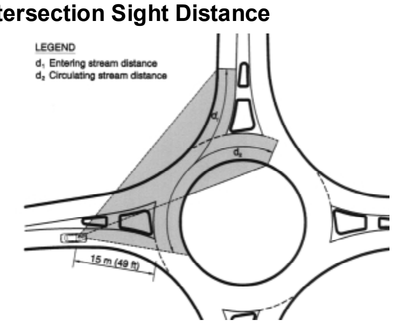
- What to do with driveways?
- Three typical cases
  - Driveways entering roundabout
  - Driveways near roundabout
  - Midblock driveways between roundabouts

Driveways Entering Roundabout

- Generally should avoid
- High-volume driveways should be designed as regular approach

Horizontal Geometry

- Intersection Sight Distance



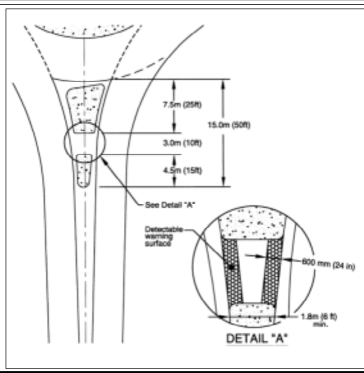
Driveways Near Roundabout

- In general, same principles as for driveways near signalized intersections
- Should not locate driveways between pedestrian crossing and yield line
- Driveways blocked by splitter island restricted to right-in/right-out

Horizontal Geometry

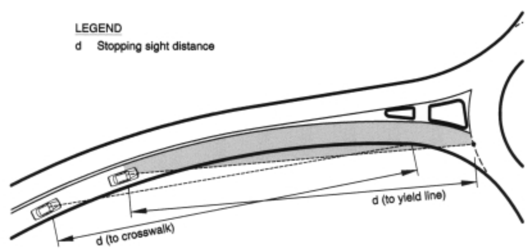
- Splitter Islands
  - should be provided on all but the very small roundabouts
  - purpose is:
    - provide shelter for peds
    - assist in controlling speeds
    - positive guidance
    - physically separate entering and exiting traffic streams
    - deter wrong way movements
    - placement of signs
  - larger splitter islands can enhance safety by providing separation between entering and exiting traffic streams

Splitter Island Length



Horizontal Geometry

- Approach sight distance



Rural Roundabouts

- Curbing
  - splitter islands

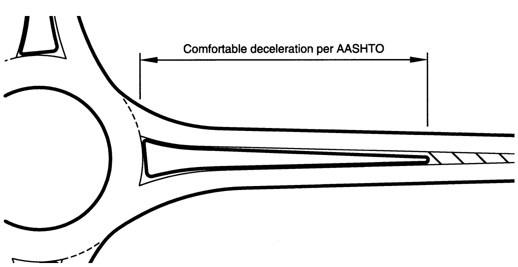


Photo: Maryland DOT

Midblock Driveways Between Roundabouts

- Ability to provide full access dependent on several factors:
  - Capacity for minor movements
  - Need for and ability to provide left-turn storage between splitter island and driveway
- Can provide U-turns at roundabouts

Midblock Driveways Between Roundabouts

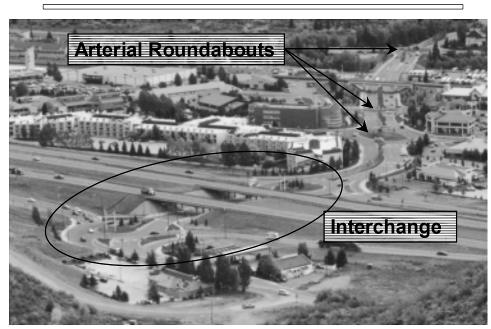
- Typical minimum centerline spacing from 120 ft roundabout for driveway with left turn storage on major street:
  - 60 ft (roundabout radius)
  - 35 ft (splitter island/pedestrian crossing)
  - 90 ft (transition)
  - 75 ft (left turn storage)
  - 30 ft (typical half-width of intersection)
- = 290 ft
- may vary depending on local standards)

Photo: Maryland DOT

Arterial Networks

- Operational effects to consider:
  - Platooned arrivals on approaches
  - Effects on downstream unsignalized intersections

Arterial Networks



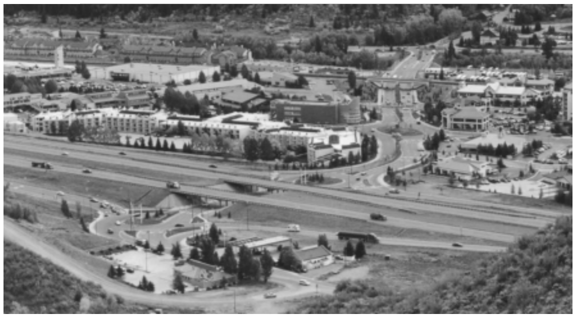
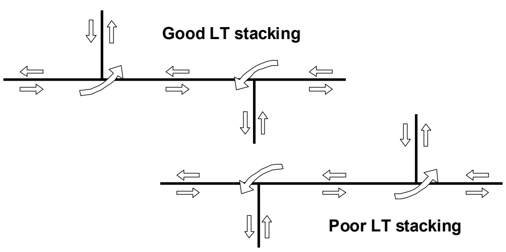


Photo: Lee Rodegerdts

Closely Spaced Roundabouts

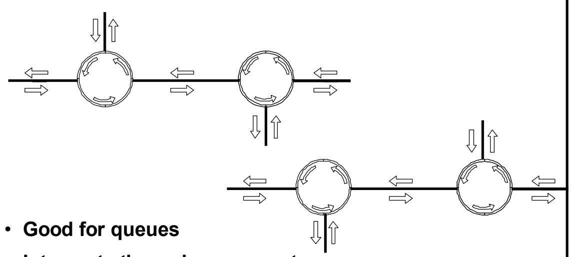
Staggered T-Intersections

- Classic problem: Where to store interior queues



Staggered T-intersections: Consecutive Roundabouts

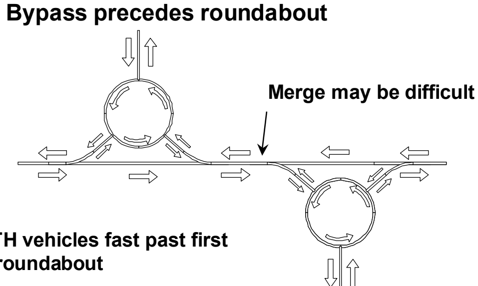
- Option A: Two roundabouts, no bypasses



- Good for queues
- Interrupts through movements

Staggered T-intersections: Through Bypass Lane

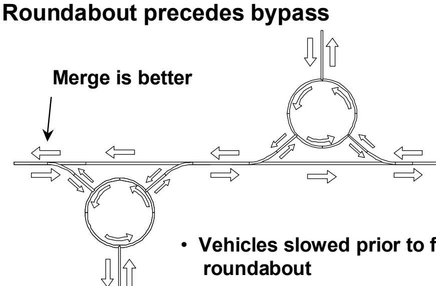
- Bypass precedes roundabout



- TH vehicles fast past first roundabout
- May create difficult merge

Staggered T-intersections: Through Bypass Lane

- Roundabout precedes bypass



- Vehicles slowed prior to first roundabout
- Better for downstream merge

Interchanges

- Number of bridges
  - Two bridges
  - One bridge
- Shape of roundabouts
  - Circular
  - Tear drop

Two Bridge Interchange

One Bridge Interchange

Circular Interchange Terminals

- Allows all movements, including U-turns
- Allows connection of frontage roads

Raindrop Interchange Terminals

- Restricts U-turns
- Makes wrong-way turns into the off-ramps more difficult

Conclusion

- FHWA Roundabout Guide allows informed decisions
- Guide supplements but does not replace fundamental documents (AASHTO, MUTCD)
- Design methods provide flexibility within guidelines
- relevant tools are provided for Access Management decisions

The future of roundabouts in the U.S.?

Swindon, England

Kittelson roundabout web site: roundabouts.kittelson.com

Modern Roundabouts as an Access Management Tool

Richard A. Perez, P.E, and Tasha Atchison

Weyerhaeuser Corporation's world headquarters is located in a semi-rural area known as East Campus in the Seattle suburb of Federal Way. Federal Way is a city of 77,000 that incorporated in 1990. East Campus annexed to the City in 1994 under an agreement wherein the City committed to maintaining a rural atmosphere in East Campus. East Campus occupies an area roughly 1 mile wide east of I-5 from approximately 2 miles long (from S 316th Street to S 349th Street).

Existing Conditions
I-5 is an 8-lane freeway on the west side of East Campus with interchanges at S 320th Street and SR18. SR 18 is a 4-lane freeway with an interchange at Weyerhaeuser Way S. S 320th Street is a 5-lane principal arterial with a signalized intersection at Weyerhaeuser Way S. Weyerhaeuser Way S is a two-lane minor arterial, with a posted speed limit of 35 mph and wide shoulders that vary between paved and gravel surfaces. S 336th Street, a minor arterial, enters East Campus from the west and ends at a wye-intersection at Weyerhaeuser Way S, locally known as "the Wye", approximately 1 mile north of SR 18. S 33rd Place, a minor collector, enters East Campus from the east and intersects Weyerhaeuser Way approximately 1/4 mile north of SR 18. The SR 18 interchange at Weyerhaeuser Way S is a diamond interchange with stop-controlled ramp terminals. S 344th Street intersects Weyerhaeuser Way S from the east just south of the SR 18 interchange.

East Campus had been developed by Weyerhaeuser with the Corporate Headquarters building (350,000 square feet) with one driveway to Weyerhaeuser Way between S 336th Street and 33rd Place S, and one driveway to S 336th Street just east of I-5. The Tech Center building, with 400,000 square feet of office space, had two driveways to Weyerhaeuser Way S north of S 336th Street. Weyerhaeuser Corporation is marketing East Campus as a location for corporate headquarters for multinational corporations. It's first success in the market was locating the headquarters of World Vision, at the south end of East Campus.

Proposed Development
Weyerhaeuser's development subsidiary, Quadrant Corporation, had identified East Campus as having a potential market for 1.5 million square feet of office space, and through further annexations, potential locations for 200 housing units. Parcels 1 and 2 (70 acres of commercial subdivision) are located on S 320th Street. Parcel 3 is located on the east side of Weyerhaeuser Way S between 33rd Place S and SR 18 and is planned for four office buildings with a total of 260,000 square feet of office space. Parcels 4, 5, and 6 are located south of SR 18 and each consists of one office building with 65,000, 48,000, and 80,000 square feet of office space, respectively. Residential North is proposed as an 82-unit detached condominium development north of S 320th Street and Residential South is proposed as a 90-unit single-family subdivision, located east of 33rd Place S northeast of Parcel 3.

Quadrant's traffic engineering consultant, The Transpo Group, was provided the task of analyzing the transportation impacts of the development. In addition to the City's concerns about mitigating the impacts of this level of development, the City was in the midst of an update of the Transportation Element of the Comprehensive Plan (including access management standards), and therefore wanted to assure that the appropriate roadway sections were provided for in the update. Weyerhaeuser Corporation also had several traffic-related concerns regarding the adequacy of the existing transportation infrastructure under existing conditions which would obviously be exacerbated by Quadrant's proposed developments. In particular, Weyerhaeuser s concerns were:

$ The use of Weyerhaeuser Way S and S 336th Street as cut-through routes for traffic avoiding the congested interchanges of I-5 at SR 18 and S 320th Street;
$ The speed of through traffic;
$ The lack of left-turn lanes at Weyerhaeuser's driveways;
$ The resultant poor levels of service for all stop-controlled approaches in East Campus;
$ Associated safety problems for Weyerhaeuser employees using any transportation mode: vehicular safety, pedestrian safety to access transit as well as street crossings of the network of trails in East Campus, and bicyclist safety due to the variable state of surfacing of roadway shoulders.

Subarea Plan
Transpo's first task was to identify any safety and capacity deficiencies and then provide a subarea transportation plan for full buildout of East Campus. Then, individual Transportation Impact Analyses were to be prepared for each development permit. However, market conditions were such that the majority of these developments ended up being fast-tracked in that draft TIA's were submitted prior to the completion of the City's review of the draft subarea plan. Nonetheless, the subarea plan was vital is reaching agreement between the City, Quadrant, and Weyerhaeuser regarding the appropriate level of improvements that would be necessary to address the transportation needs in a holistic fashion.

The existing conditions that were documented in the plan included the following:

$ Despite the 35 mph posted speed limits, the 85th percentile speeds were between 45 and 50 mph through East Campus;
$ The south intersection of the Wye was failing, and met warrants for signalization;
$ The east driveway from Weyerhaeuser Corporate Headquarters was failing and met warrants for signalization;
$ The 33rd Place S approach at Weyerhaeuser Way S was failing and would meet warrants for signalization when Residential South was constructed;
$ Left-turns out of either driveway from Parcel 3 (the dominant movement during the evening peak hour) would fail and would meet warrants for signalization;
$ The SR 18 westbound off-ramp was failing and met warrants for signalization;
$ The SR 18 eastbound off-ramp was failing and met warrants for signalization and had an accident rate of 1.25 collisions per million entering vehicles;
$ Weyerhaeuser Way S would need to have at least four lanes between the Wye and SR 18.

If all the locations where signal warrants were forecast to be met were signalized, the result would have been six traffic signals in slightly more than 1 mile of Weyerhaeuser Way.

City Standards
The City's access management standards (then draft, now adopted) can be summarized in the following table:

City of Federal Way Access Management Standards

Access Classification	Median	Through Traffic Lanes	Minimum Spacing (Feet)*					Minimum Signal Progression Efficiency***
			Crossing Movements	Left-Turn Out	Left-Turn in	Right-Turn Out	Right-Turn In	
1	Raised	6	Only at signalized intersections	Only at signalized intersections	330	150	150	40%
2	Raised	4	330	330	330	150	150	30%
3	Two-Way Left-Turn Lane	4	150	150**	150**	150**	150**	20%
4	Two-Way Left-Turn Lane	2	150**	150**	150**	150**	150**	10%

* Greater spacing may be required in order to minimize conflicts with queued traffic at the street s design year 95^{th} percentile.
** Does not apply to Single Family Residential uses.
*** If the existing efficiency is less than the standard, new traffic signals may not reduce the existing efficiency.

$ Raised medians will be required if any of the following conditions are met:
1. There are more than two through traffic lanes in each direction on the street being accessed.
2. The street being accessed has a crash rate more than 10 crashes per million vehicle miles, if the street currently has a two-way left-turn lane.

$ Two-way left-turn lanes will be required if the street being accessed has a crash rate more than 10 crashes per million vehicle miles, if the street currently has no left-turn lane.

Weyerhaeuser Way S had been planned as a five-lane roadway, putting it in Access Class 3. Access Class 3 allows full access every 150 feet. However, attaining 20% signal progression efficiency would have been challenging at best had all the locations that would have met signal warrants been signalized.

All parties agreed that this level of signalization would have violated the annexation agreement's condition requiring that a rural atmosphere be maintained in East Campus. Quadrant was also concerned about the construction cost of this number of signals. The City was concerned about the additional maintenance expense (although the City had established a precedent of requiring benefiting developments to pay for the operation and maintenance expense of traffic signals installed at intersections for private access) and the difficulty in attaining adequate signal progression. However, left-turn movements onto Weyerhaeuser Way S would have been inherently unsafe due to the peak hour volumes being so far beyond capacity. If those movements were prohibited, U-turn volumes would have required left-turn phases at T-intersections, thus complicating further the attainability of adequate progression.

Proposal
Due to the Wye's nonstandard configuration and failing level of service, the City had a project listed in its 6-year Transportation Improvement Plan to realign and signalize this intersection. However, due to its unique availability of right-of-way and desire to maintain the rural atmosphere of East Campus, City staff was considering the Wye as a potential location for a roundabout. Knowing City staff was not vehemently opposed to the concept of a roundabout, Transpo considered the possibility of using a roundabout at other locations and concluded that one could be located at 33rd Place S.

The proposed plan would prohibit left-turns from driveways at Parcel 3 and Weyerhaeuser Corporate Headquarters east driveway onto Weyerhaeuser Way S. U-turns would be signed explicitly at the roundabout. It should also be noted that this will be the first roundabout operated as multi-lane in Washington State.

Design Guidelines
WSDOT has issued a draft "Roundabout Resource Reference" to local agencies. In it, WSDOT is recommending that multi-lane roundabouts not be constructed until more is learned about the operation of single-lane roundabouts. One of the leading proponents of roundabouts in the US, Leif Ourston of Ourston and Doctors in Santa Barbara CA, has suggested that such a policy is a major mistake. Ourston recommends that each agency start with an intersection with the biggest problems because if one starts with a small intersection, decision-makers may conclude that it can only work at small intersections. His point was borne out with respect to the first roundabout in Washington at University Place. University Place's City Council, in a resolution one year following the completion of the roundabout at Olympic Boulevard and Grandview Drive, concluded that it was a success, but they would not consider implementation of roundabouts on Bridgeport Way, their busiest arterial. Federal Way staff has concluded that roundabouts would not work at its two highest volume intersections (6300 and 6400 vehicles per hour), even as 4-lane roundabouts with right-turn bypass lanes, so there are definite limitations, but WSDOT's position may limit the political viability of roundabouts at locations where they may be the most appropriate solution.

Roundabouts have several advantages over stop-controlled and signalized intersections. These include:

$ Substantial reduction in delays over signalized intersections;
$ Improved capacity for side streets over two-way stop-control;
$ Improved capacity over signalized intersections;
$ Reduction in both collision rates and collision severity over other types of intersection control;

$ Potential for traffic calming effects;
$ Landscaping opportunities in the circular roadway.

These benefits are achieved as a result of particular design features that help distinguish roundabouts from more traditional rotary intersections as found in the East Coast or traffic circles as used for traffic calming. The biggest difference is that no approach has priority; all approaches yield to traffic in the circulating roadway. Deflection is an important feature that reduces travel speeds on approaches and around the circle, thus reducing the potential for rear-end collisions. The small circulating roadway radius ensures that travel speeds on the circulating roadway are less than 25 mph. Thus, small gaps (1.5 to 3.5 seconds) can be used for vehicles entering the circulating roadway. This is what provides greater intersection capacities for minor street approaches.

There are two general schools of thought regarding roundabout design: British and Australian. No national standards exist in the United States at this time, but Maryland and Florida have adopted guidelines that clearly prefer Australian principles. WSDOT appears to be heading that direction as well. In general, Australian designs appear more consistent with US design standards and capacity procedures. This is reflected in signing and marking primarily as Australia s standards appear more consistent with US driver expectancy. Capacity procedures are based on gap-acceptance studies consistent with Highway Capacity Manual procedures whereas the British methodologies are based on empirical equations developed from a data set that includes several roundabouts that do not conform to modern standards. Although the design of the 33rd Place S roundabout is based largely on Australian design procedures, we have attempted to consider British methodology as well in the design. Nonetheless, we have designed a roundabout that differs from Maryland and Florida (and draft WSDOT) standards in a couple instances.

One area of challenges to implement the basic precept of improving safety at roundabouts is the issue of deflection. Roundabouts are generally very effective at reducing both the number and severity of collisions compared to both signalized and two-way stop controlled intersections because drivers are required to deflect their travel paths around the splitter islands and the central island. The minimum radius of the shortest travel path defines the design speed of the roundabout. It is generally simple to maintain low design speed deflections with single-lane roundabouts. However, multi-lane roundabouts have a wider potential travel path (assuming all lanes are used), thus the deflection radius increases dramatically. This may be one of the reasons that WSDOT is recommending that multi-lane roundabouts not be constructed at this time. In this roundabout, deflection radii exist as large as 430 feet, corresponding to a design speed of 34 mph.

Because U-turns movements were to be encouraged to account for the traffic departing the office buildings, U-turns are signed explicitly using diagrammatic guide signs on the roundabout approaches, with 15 mph advisory speed plates mounted underneath. Also, lane use control signs will be installed to provide advance guidance through the roundabout. Yield signs will not include the standard "to Traffic on Left" riders as this appears redundant. Rhetorically, approaching on the stem of a T-intersection with a yield sign and a one-way sign pointing to the right, who else would one yield to? The Maryland guideline provides a diagrammatic roundabout warning sign, whereas the Florida guidelines consider this inconsistent with the MUTCD. Florida recommends using a Roundabout Ahead text warning sign instead, however, City staff decided that the diagrammatic guide sign would adequately warn drivers of something being very different, and after having driven one, would know what to expect.

One particular issue was the handling of bicycle lanes. As skill levels vary, the bicycle purist would prefer to have a bike lane striped through the roundabout, but all design guidelines discourage such treatment, as this striping might confuse users about right-of-way rules in crossing bike lane stripes. The lower-skill cyclist would prefer to use the sidewalk around the roundabout, but hardcore cyclists would not use it. Ultimately, the issue was decided by providing cyclists the choice of either staying in the roadway or using the sidewalk. Advance signing informs the cyclist "Bikes use sidewalk or merge left". At this location, a curb ramp is provided for cyclists wishing to use the sidewalk and the bike lane striping ends. At this point, the lane stripe tapers over to the widths provided at the roundabout yield line, which coincidentally, is 1 foot wider than the half street with the bike lane. Hence the pavement only widens one foot but the lanes are striped to taper from 11 and 12 feet (with a 5-foot bike lane) to 14 and 15 feet. Bike lane striping resumes after the crosswalk where bicyclists using the sidewalk would reenter the roadway.

Another issue of some discussion was the provision of sidewalks around the roundabout. As these sidewalks would be expected to be shared with some bicyclists (presumably traveling only counterclockwise), the original staff recommendation was for 8-foot sidewalks. Also, standards are very uniform in their discouragement of curbside sidewalks at roundabouts, as this might encourage pedestrians to cut across the roundabout through the central island; therefore 5-foot planter strips were also requested. However, due to right-of-way constraints, only 5-foot curbside sidewalks will be provided.

Pedestrian access is a concern at this location, as it will be the transit stop for both Residential South and Weyerhaeuser Corporate Headquarters (a CTR-affected worksite). The placement of crosswalks at roundabouts is not consistent with US practice at normal intersections. All standards suggest moving the crosswalk approximately 20 feet away from the yield line on approaches. The theory is that drivers at the yield line will be watching for gaps in the circulating roadway. Therefore, it is safer to have pedestrians cross where other drivers will be queued. The splitter islands, which help provide deflection to approaching traffic, also provide a center refuge island for pedestrians.

WSDOT is recommending that all crosswalks be marked at roundabouts. The City contends that marking crosswalks should be based on volume warrants, and that curb ramps and cutouts through the splitter islands would be adequate guidance for pedestrians to determine the appropriate place to cross. Furthermore, the City installs pedestrian warning signs at all marked unsignalized crosswalks and to add these signs would likely result in sign clutter, which would conflict with the rural atmosphere that we are attempting to preserve. Nonetheless, crossings and signing will be installed.

Summary
In this instance, the roundabout satisfied several concerns for all project partners. Access management will be implemented beyond the City's driveway spacing requirements and the issue of signal coordination is rendered moot. Construction costs will be less than the construction of several signals. Operation expenses will also be less than for signalized intersections. (As a side note, Weyerhaeuser will be responsible for maintaining the landscaping in the roundabout). Roadway safety will be improved over signalization due to reduced number of conflict points and the fact that roundabouts generally operate more safely than signalized intersections, and roadway speeds may be reduced as well. Finally, the rural atmosphere will be maintained by eliminating the need for signals and providing landscaping opportunities.

Conclusions
The roundabout at 33rd Place S will begin construction in the fall of 1999, with completion expected early in 2000. Assuming the project is successful, the Wye will be converted to a roundabout in 2001.

Roundabouts can be a useful access management tool. The goals of access management are improving roadway safety and preserving capacity. Advantages of roundabouts include:

$ Improved roadway safety;
$ Ability to accommodate high U-turn volumes;
$ Maintained arterial capacity;
$ Less usage of signalization;
$ Improved side street capacity.

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Acknowledgments
The design of this roundabout was a highly collaborative effort. All parties involved recognized the need to provide a successful design that would meet the project goals of maintaining a rural atmosphere in high volume conditions as well as encourage the appropriate use of roundabouts elsewhere in Washington State. The authors wish to acknowledge the following contributors to the design:

$ Maryann Olson, The Transpo Group, final traffic design
$ Hicham Chatila, P.E., The Transpo Group, conceptual and final traffic design
$ Steve Kitterman, P.E., ESM Consulting Engineers, final civil design
$ Ed Lagergren, P.E., Washington State DOT, conceptual design
$ John Diaz, P.E., KDD Associates, conceptual and final design

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Tasha Atchison has worked for the past four years at The Transpo Group, a consulting firm in Kirkland, Washington, specializing in transportation planning, design, and operations. Her focus has been shared between intermodal studies for transit systems, rail, transit-oriented development, and traffic planning studies. Her planning work often leads to the need for capacity and traffic control design measures, which in some cases has lead to the need for roundabout implementation.

Modern Roundabouts
As An
Access Management Tool

4th National Access Management Conference
August 15, 2000
Portland, Oregon

Richard A. Perez - City of Federal Way
Tasha Atchison - The TRANSPO Group

Why Roundabouts?

- **Background**
- **Conditions**
- **Alternatives**
- **Application**

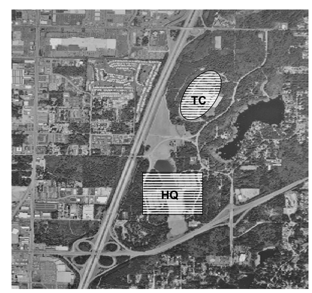
Background

Background

Weyerhaeuser
<u>East Campus</u>

HQ Headquarters

TC Technical Center

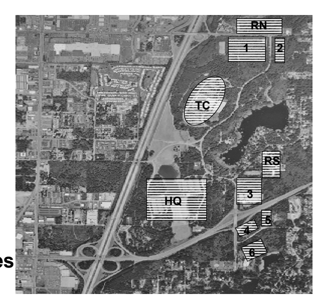


Background

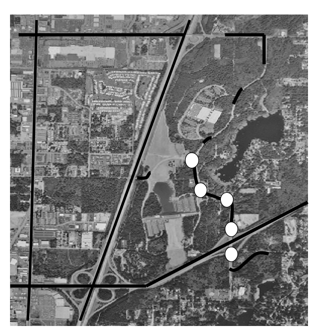
<u>Quadrant Development</u>

1. **50 Acres Commercial**
2. **10 Acres Commercial**
3. **260,000 SF Office**
4. **65,000 SF Office**
5. **65,000 SF Office**
6. **120,000 SF Office**

RN 82 Townhomes
RS 90 Single Family Homes



Conditions



- **Congestion**
- **Poor Level of Service**
- **Need for Roadway Widening**

Conditions

Signals Warranted at

- "The Wye"
- Headquarters Driveway
- S 33rd Place
- Parcel 3 Driveway
- SR 18 Westbound & Eastbound Ramps

Conditions

Safety

- High Travel Speeds
  - 85th Percentile = 45 MPH
  - Posted Speed = 35 MPH
- Poor Sight Distance
  - "The Wye"
  - S 33rd Place
  - Headquarters Driveway

Conditions

Safety continued…..

- Minimal Non-Motorized Facilities
  - Gravel Shoulders
  - No Bike Paths
  - Transit Zones not ADA Compatible
- High Accident Rates
  - SR 18 Eastbound Ramp - 1.25 acc/mev

Alternatives

Stakeholders Goals

- City of Federal Way - Address Transportation Needs
- Weyerhaeuser - Maintain Safety & Rural Character
- Quadrant - Economic Feasibility

Alternatives

Design Considerations

- Provide Traffic Progression
- Left-Turn Capacity from Private Access and Minor Collectors
- Maintain Rural Character
- Low Maintenance Costs

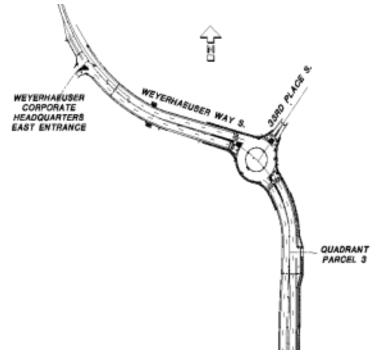
Alternatives

- Six Traffic Signals
- Alternate Access Management

Application

- Roundabouts
  - At “The Wye" Intersection
  - At Weyerhaeuser Way/S 33rd Place
- Roadway Widening
- Turn-Lane Improvements

Application



Application

Roundabout Advantages Over Other Types of Intersection Control

- Reduction in Vehicle Delay
- Improved Capacity
- Reduction in Collision Rates and Severity
- Potential for Traffic Calming
- Landscaping Opportunities

Application

Design Features

- Approaches Yield to Circulating Traffic
- Deflection on Approaches to Slow Entering Traffic Speeds
- Roundabout Radius Regulates Circulating Travel Speeds
- Accommodate Pedestrians & Bicyclists

Application

Methodology for Design

- British
- Australian
  - Adopted by Maryland & Florida

Application

Design Features

- Deflection
- Approach signs
- Bike Lanes

Application

Design Features

- Sidewalks
- Crosswalks

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KDD Associates

- John Diaz, P.E.

Conclusions

Project Status

- Opened May 2000
- Potentially Roundabout Constructed at ”The Wye" in 2002

Conclusions

Roundabouts For Access Management

- Improve Safety
- Accommodate High U-Turn Volumes
- Maintain Arterial Capacity
- Reduce Number of Traffic Signals
- Improve Side Street Capacity